

VECTORS vs SCALAR

A *scalar* quantity is one that can be described by a single number:
temperature, speed, mass

A *vector* quantity deals inherently with both magnitude and direction:
velocity, force, displacement

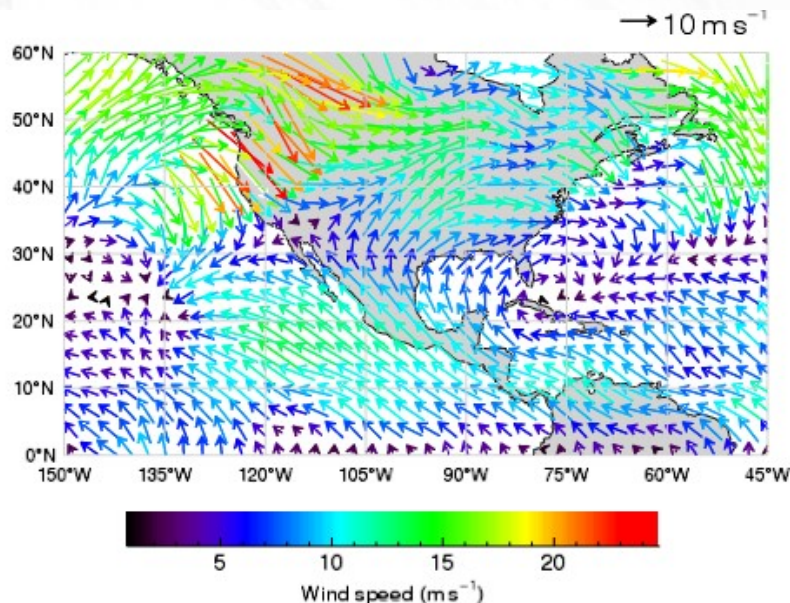
HOW MUCH ? OF WHAT ? WHICH WAY ?

WHICH quantity is not a vector

1. force
2. speed
3. acceleration
4. displacement

WHICH quantity is a scalar

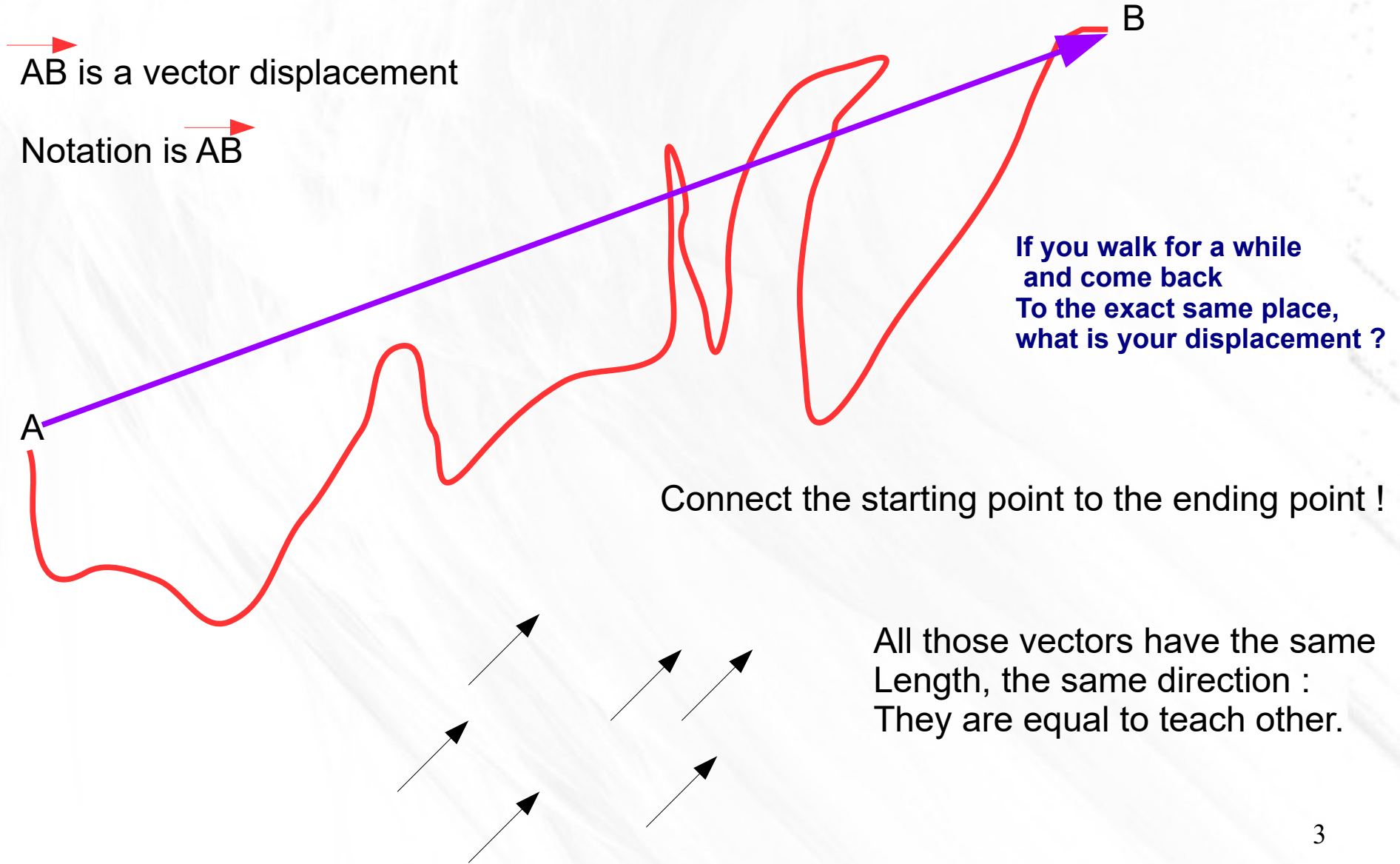
1. distance
2. velocity
3. acceleration
4. displacement



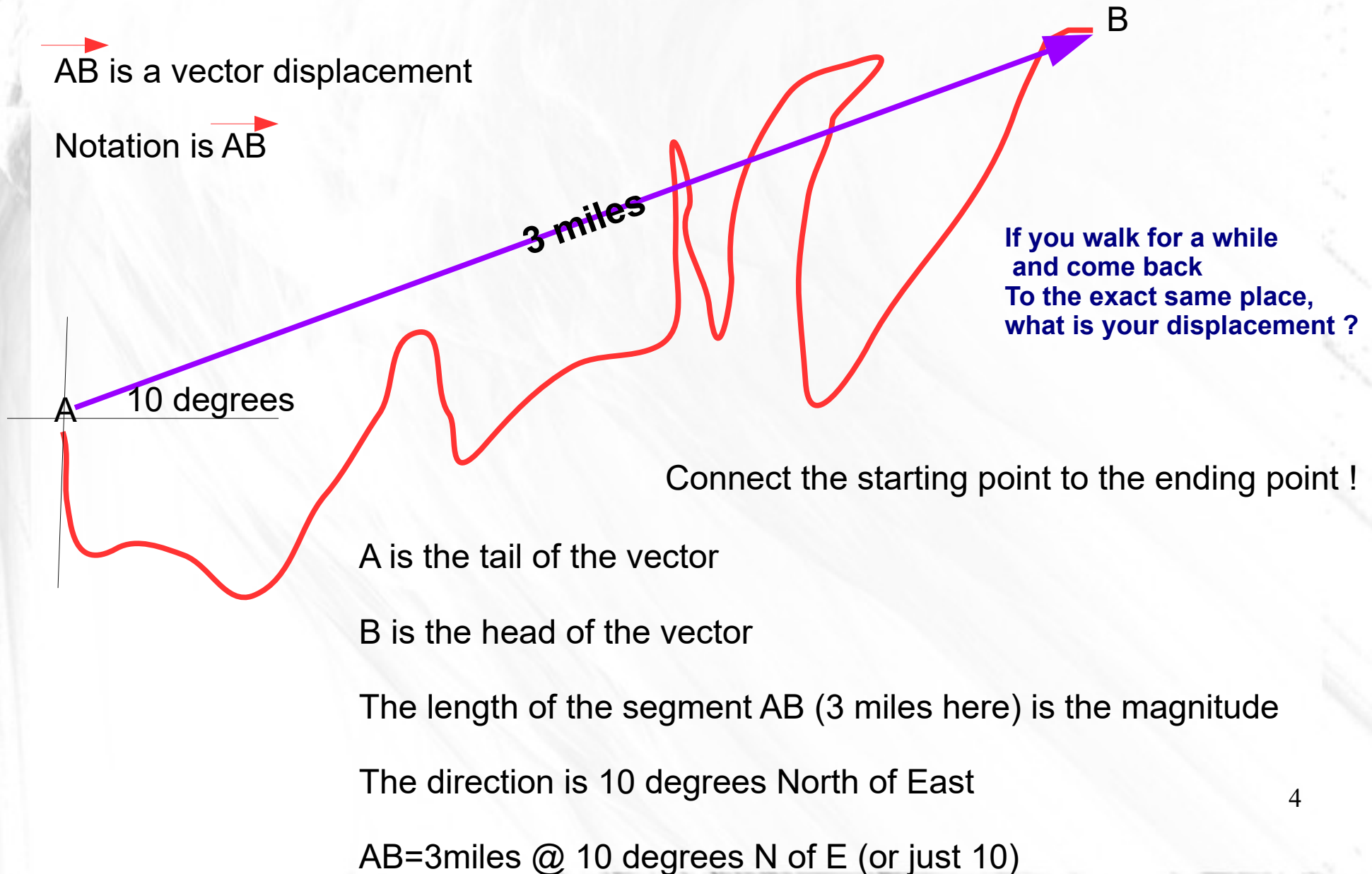
This map shows the velocities of the Wind. The velocities have a magnitude (speed of wind from 0 to 25. The length of the arrows are proportional to the magnitude), a direction (which way), And a unit (m/s).

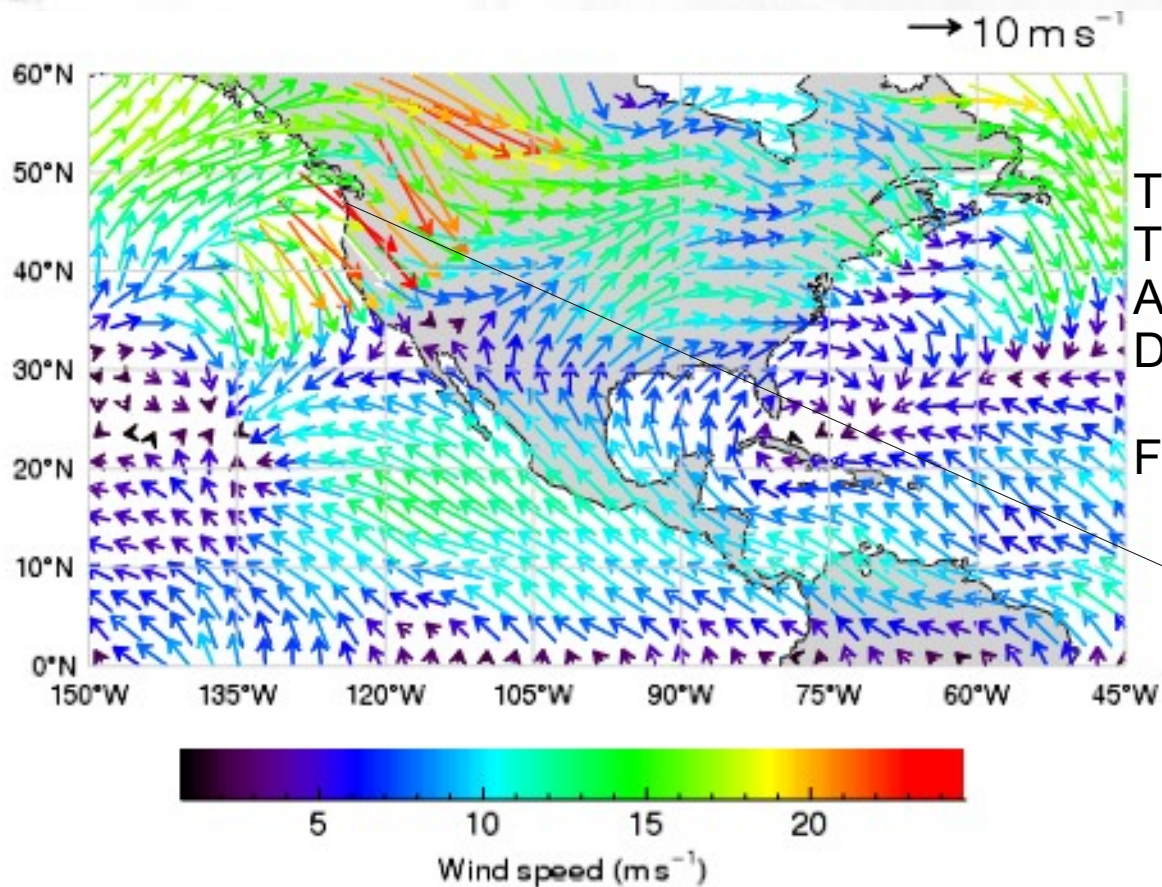
Colors are also used to show the magnitude. ²
<https://www.harrisgeospatial.com/docs/vectors.html>

Trace the vector displacement : connect the starting point A to the end point B. A is the tail of the vector and B the head.



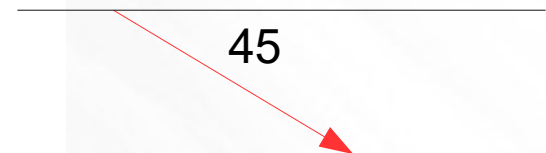
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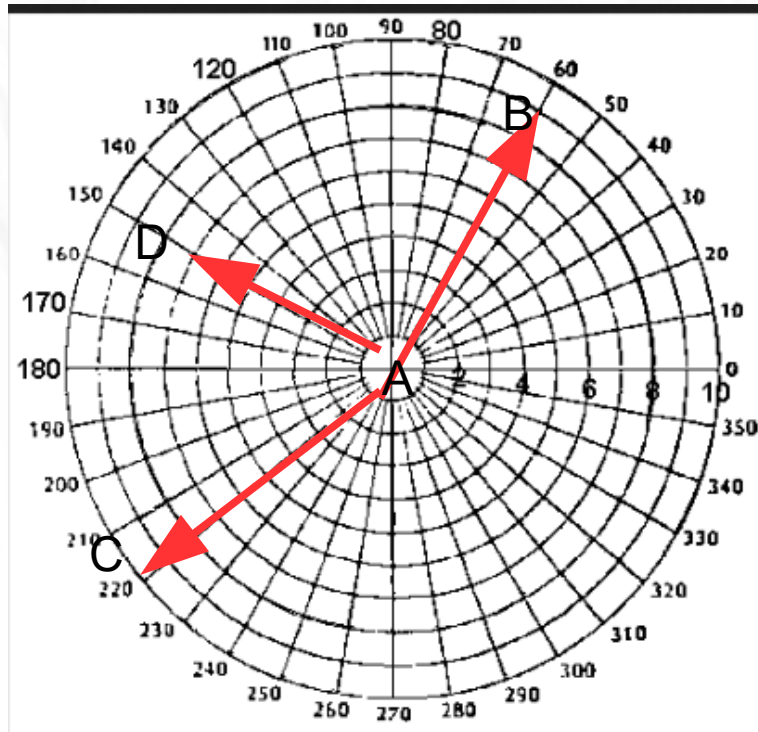
These are velocity vectors.
The magnitudes are given by the colors
And by the scale at the top right of figure.
Direction can be approximated.

For example:



30m/s @ 45 degrees south of east

Polar coordinates of vectors or standard notation



In polar coordinates, the angle increase
From the positive x-axis counterclockwise
From 0 to 360

For example vector AB = 9 units @ 60

AC = 10 units @ 220

This is called the standard notation for
Vectors.

AD =



The vector represents the displacement
 NYC – Detroit.
 It has magnitude, a unit, a direction

Displacement = _____ @ _____
 The distance in blue is a scalar.

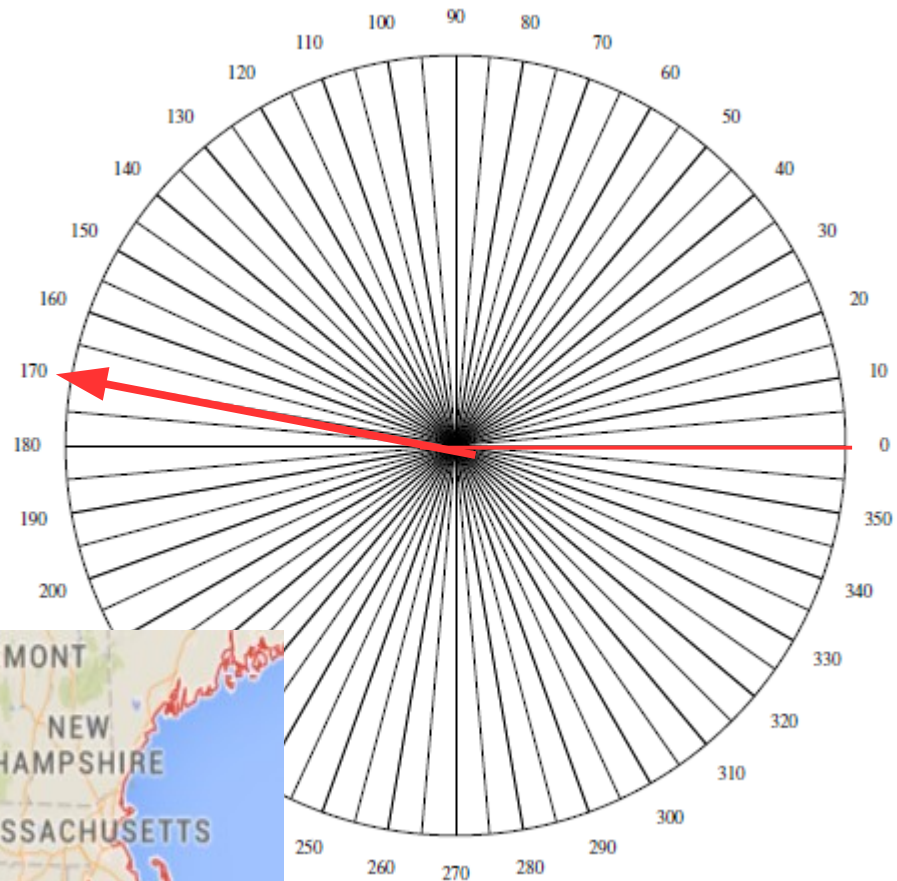


Displacement = 600miles @ 10 degrees N of W

In Physics / Math we prefer
The notation:

600 miles @ 170

It is the polar notation
Or standard notation
See doc polar coordinate.



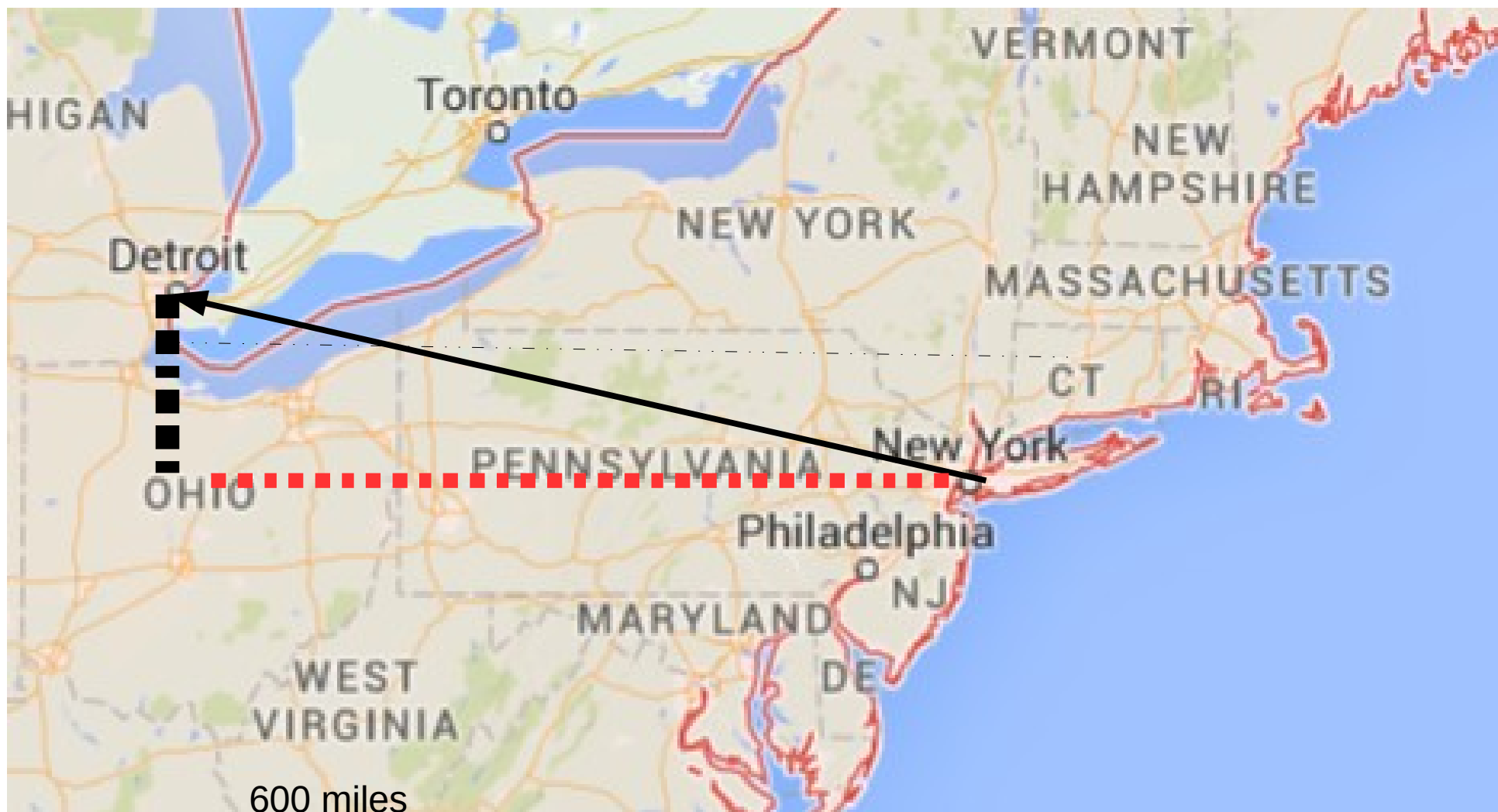
In the shared folder you
Will find the circle above.

VECTORS in PARTS: components of vectors

Vectors come in parts. A vector has 2 components in 2D.

**A horizontal component along the x-axis or W-E direction
and a vertical component along the y-axis or the S-N direction**

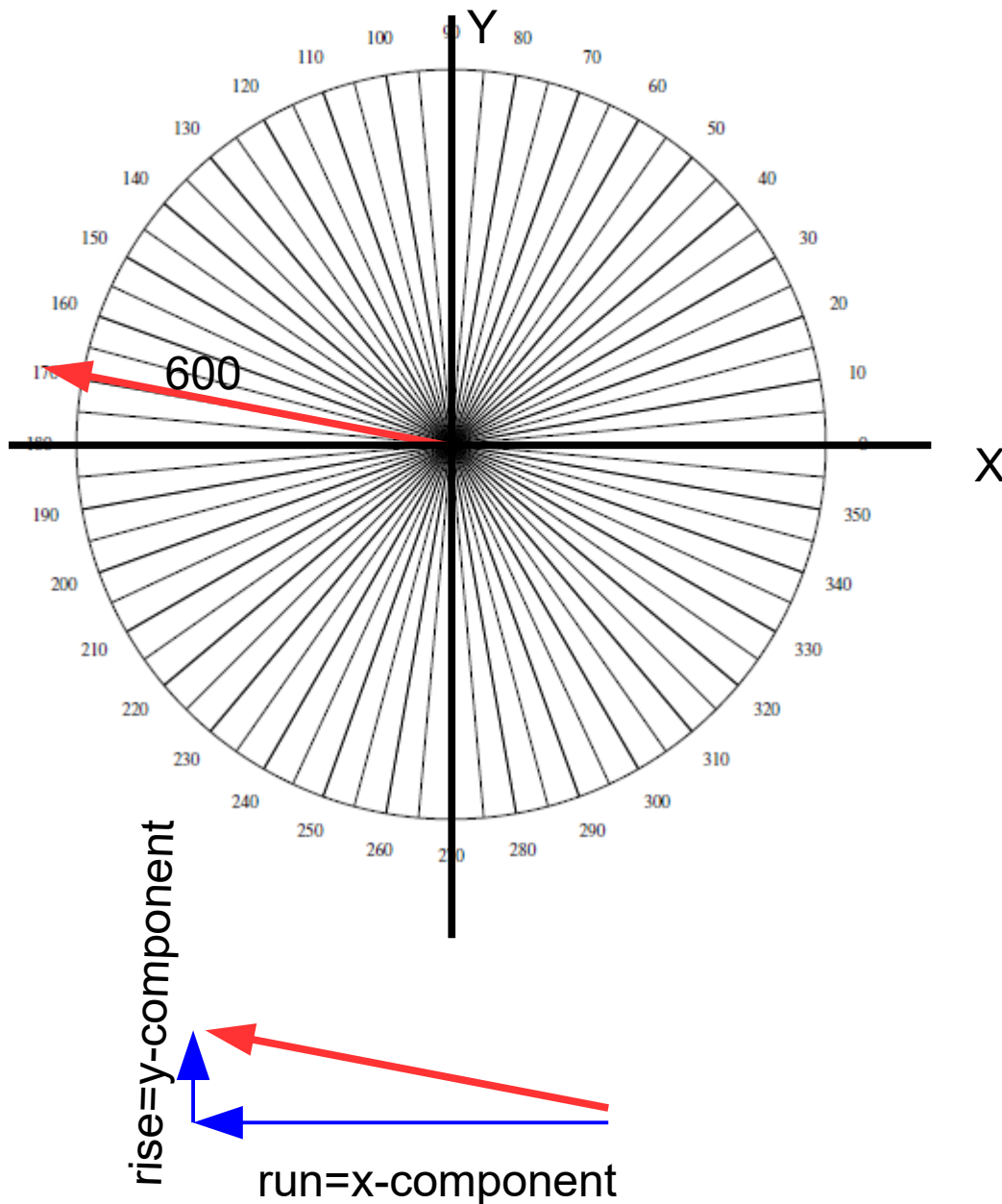
Here you can find how far in the West direction and how far in the North direction



Find the components of the vector displacement.

The magnitude is 600 miles and the angle is 10 degree. Use trig.

From tail run then rise/fall to find the head.

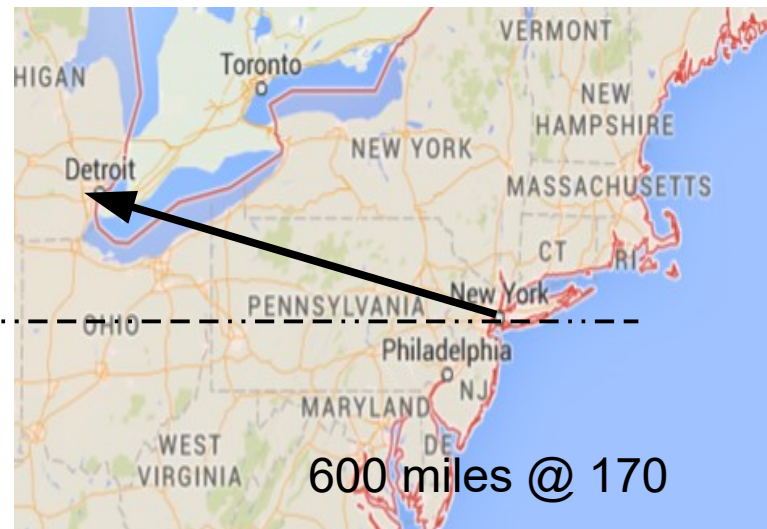


How far west ? \rightarrow x-component
(run)

$$600 \cos(170) =$$

How far North ? \rightarrow y-component
(rise/fall)

$$600 \sin(170) =$$

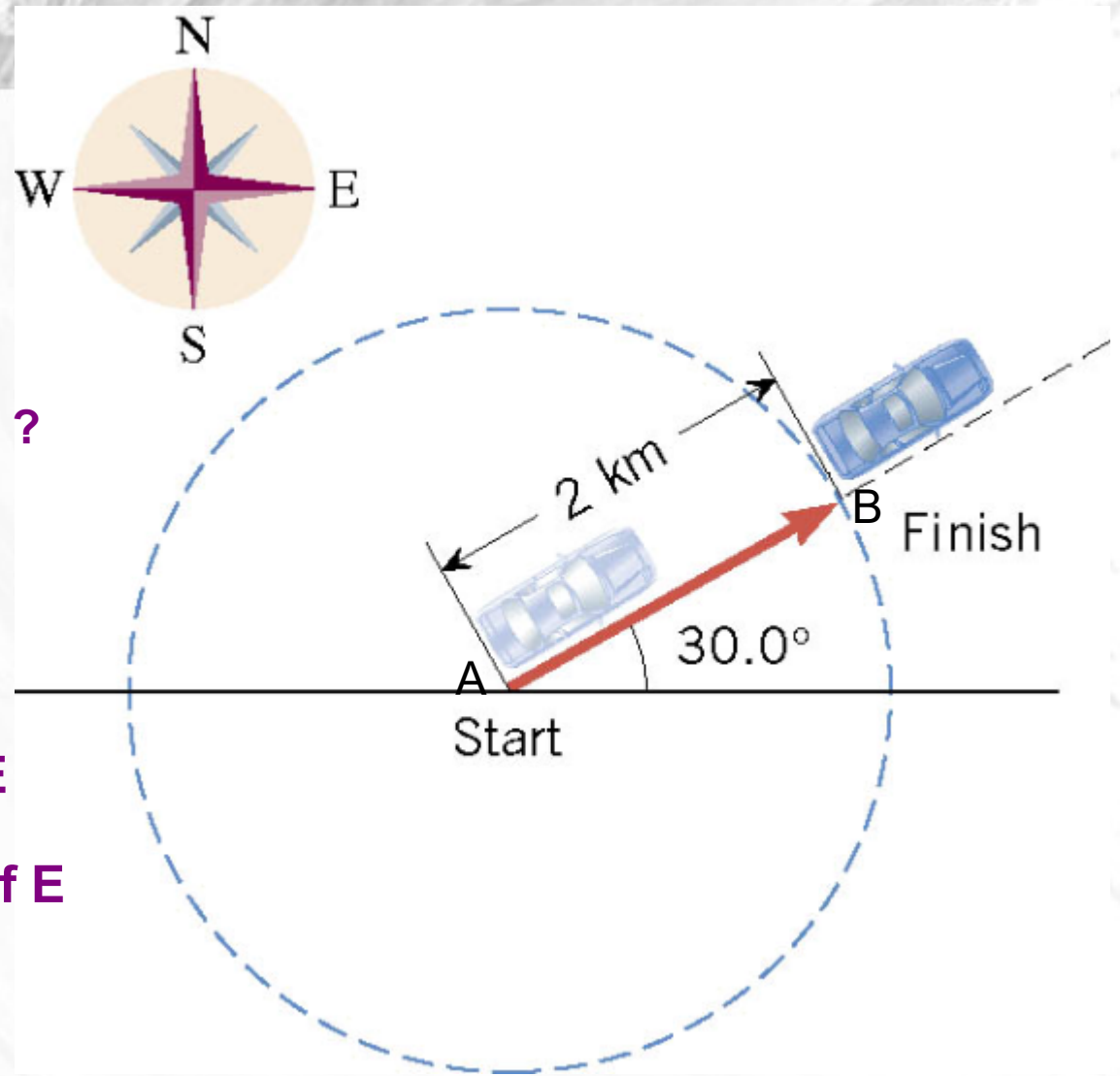


finding components of vectors

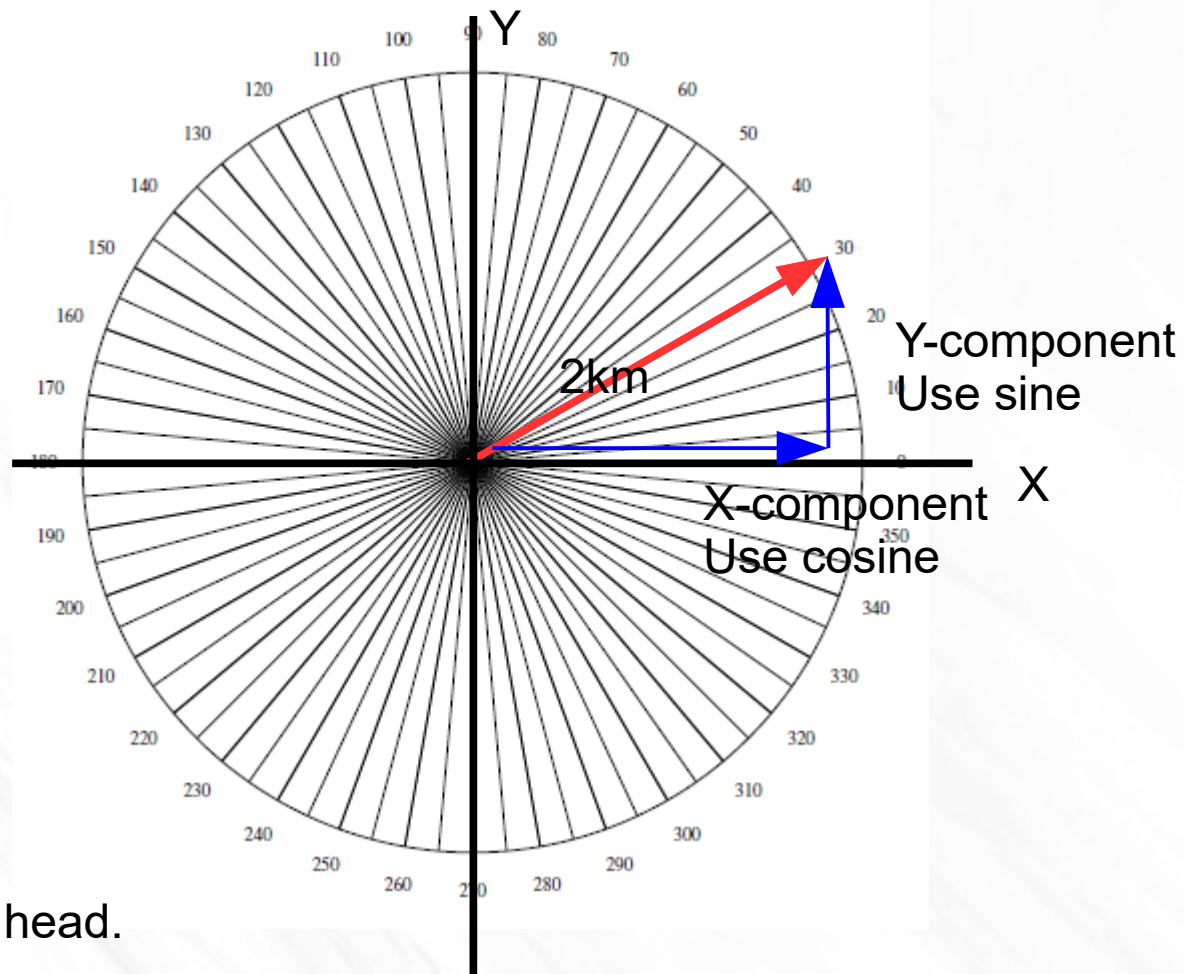
- Vector has a magnitude + direction
- Attach the tail of the vector at the origin of a x-y coordinate system. Keep the direction the same.
- Using a polar graph find the angle in the circle. (go counterclockwise)
- X-component is magnitude \times cosine(angle)
- Y-component is magnitude \times sine(angle)

What is the displacement of the car ?
(2 answers are correct)

- ➡ 1. $AB = 2\text{km @ } 30 \text{ degrees}$
- ➡ 2. $AB = 2 \text{ @ } 30 \text{ degrees N of E}$
- ➡ 3. $AB = 2\text{km @ } 30 \text{ degrees N of E}$
- ➡ 4. $AB = 2 \text{ km @ } 170 \text{ degrees N of E}$

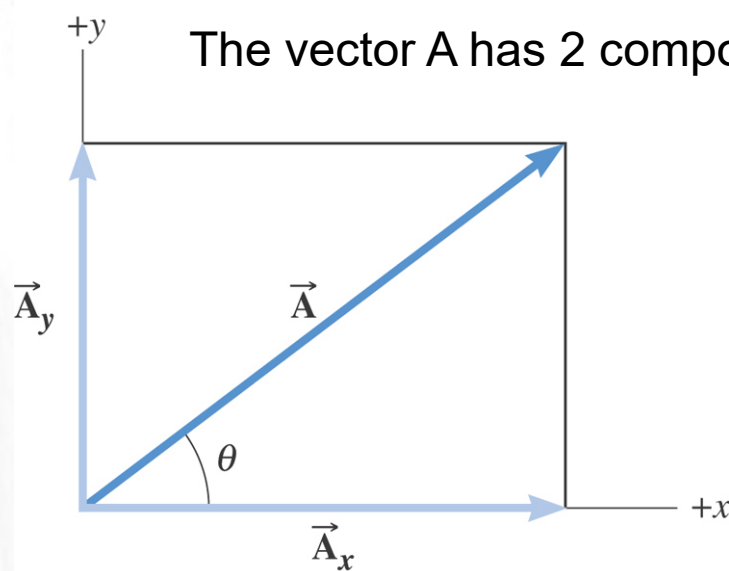


**Compute the components of the vector displacement
(x-component and y. component) See next slide.**

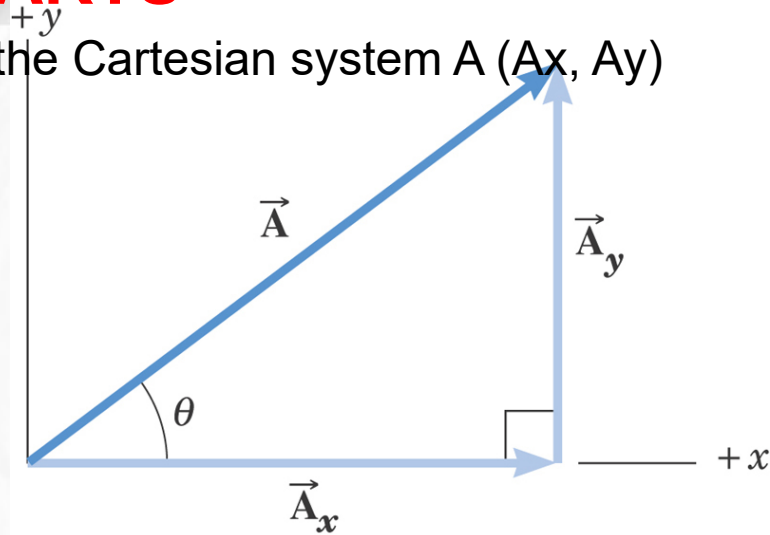


From tail run
Then rise to find head.

VECTORS in PARTS



The vector A has 2 components in the Cartesian system A (A_x, A_y)



If **A is a vector displacement** (walking/moving from start to end)
Then A_x is the horizontal displacement or x-component.
(how far did you move along horizontal or here @ east).
 A_y is the vertical component or y-component how far did you move
along vertical or here @ North).

If **A is a velocity**. A_x is how fast you move along horizontal
Or how fast you move @ east. A_y is how fast you move along
Vertical or @ North.

If **A is a force**. A_x is pull/push along the east. A_y the pull/push along
west

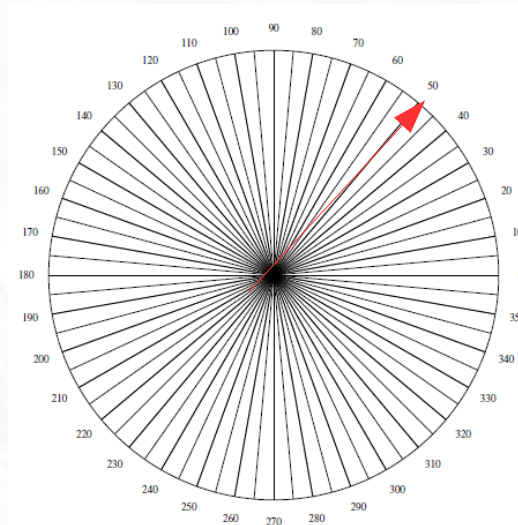
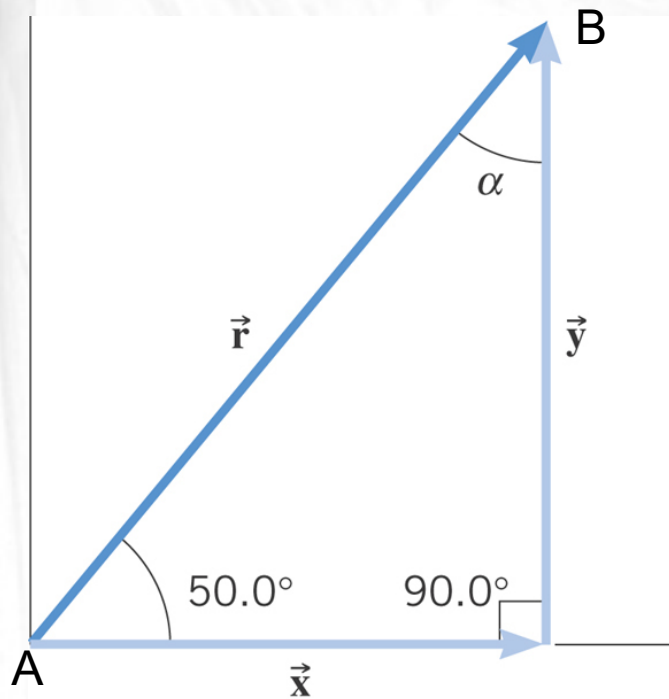
Example

A displacement vector has a magnitude of 175 m and points at an angle of 50.0 degrees relative to the x axis. Find the x and y components of this vector.

- **R = 175m@50 degrees CCW about x-axis**

X and Y (round to nearest one) :

1. 209m m and 134 m
2. 134m and 113m
3. 113m and 134m



A) During the execution of a play, a football player carries the ball for a distance of 33 m in the direction 76° north of east. To determine the number of meters gained on the play, find the northward component of the ball's displacement.

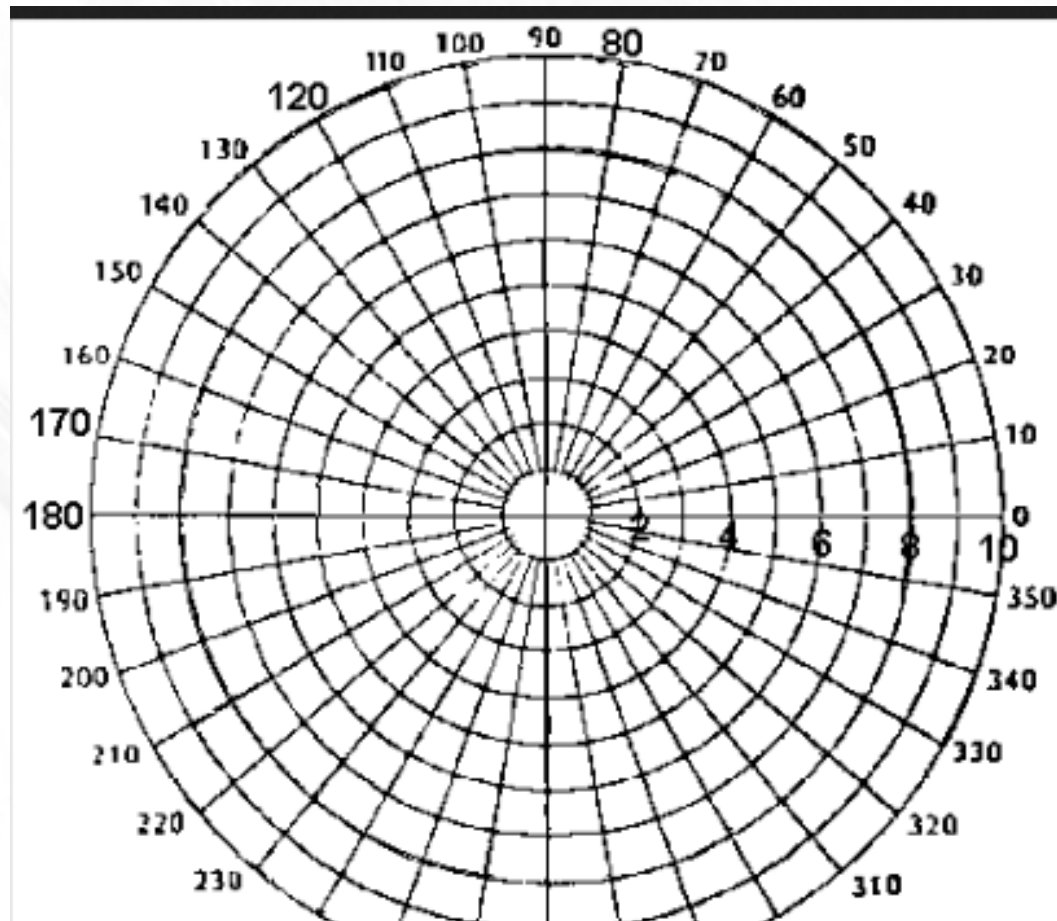
a) 8.0 m

b) 16 m

c) 24 m

d) 28 m

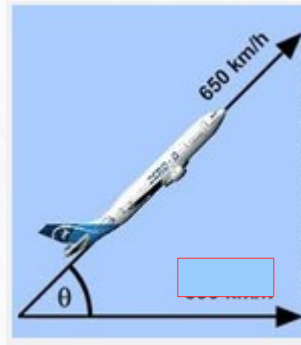
e) 32 m



$$33\sin(76)$$

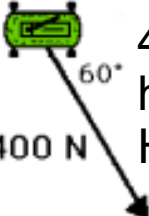
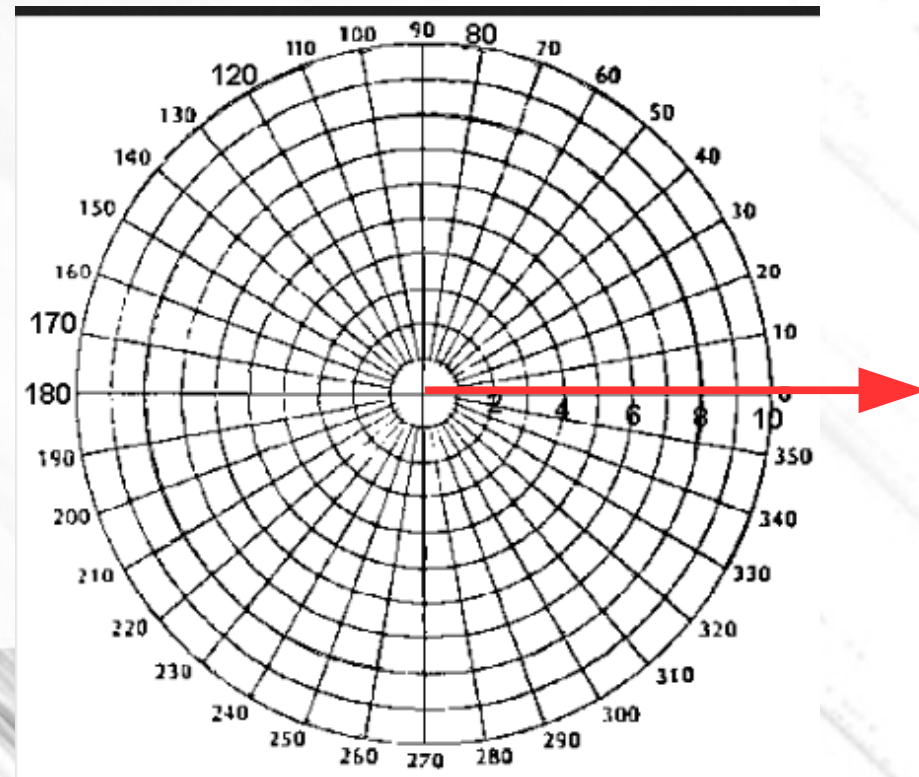


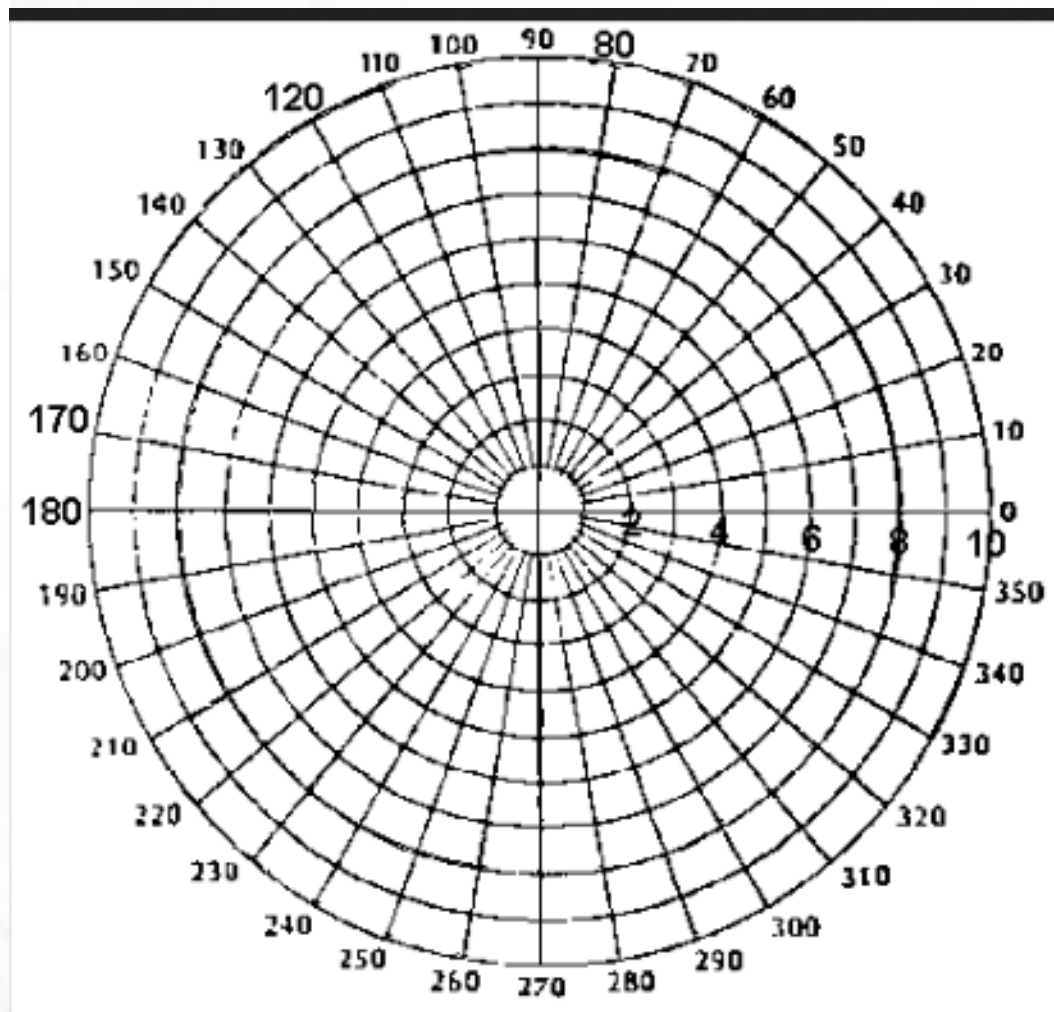
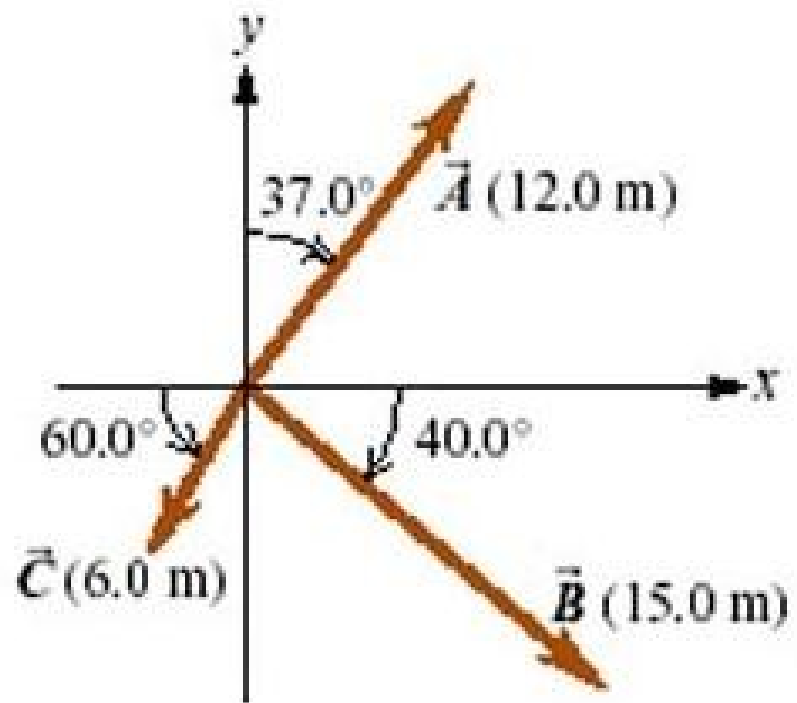
2) $F = \underline{\hspace{2cm}}$ @ $\underline{\hspace{2cm}}$
 What is the pull @ east
 What is the pull @ north



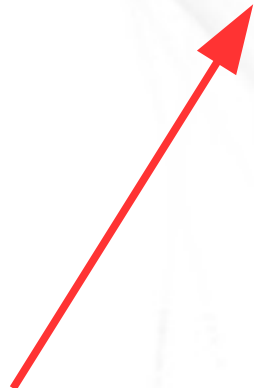
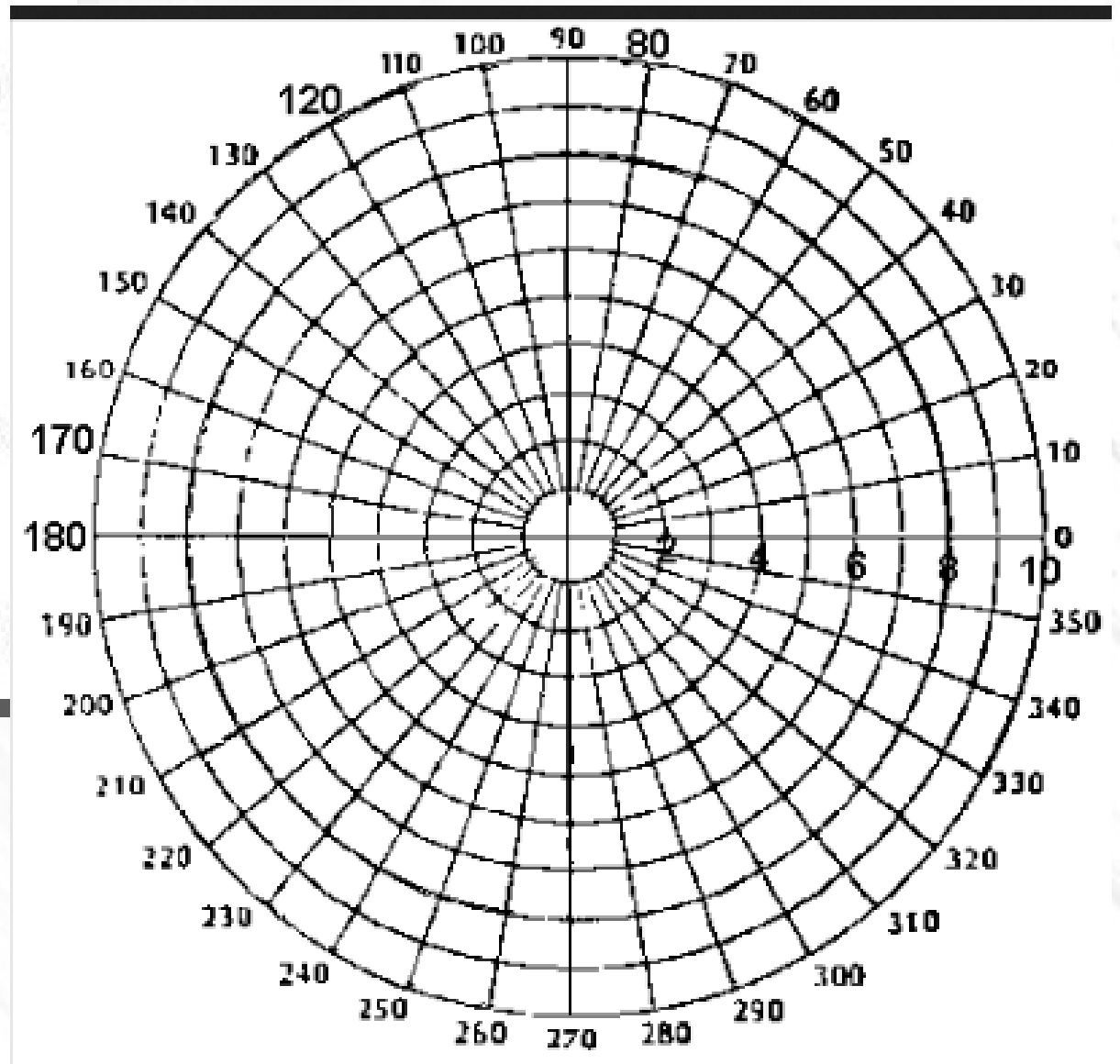
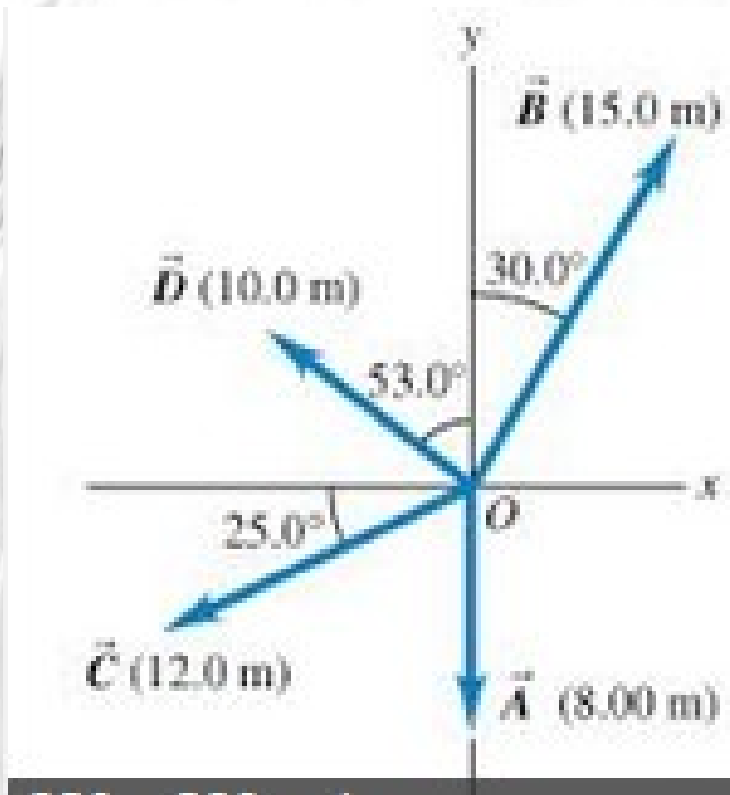
3) $V = \underline{\hspace{2cm}}$ @ 45
 how fast it is going @ east
 How fast it is going to North

4) $F = \underline{\hspace{2cm}}$ @ $\underline{\hspace{2cm}}$
 how much the wind is pushing @ east
 How much the wind is pushing @ south



Find the components of each vector



Find the components of each vector

Assignment:

<https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-trig-ratios-intro/v/basic-trigonometry>

(0) Sum angles = 180°

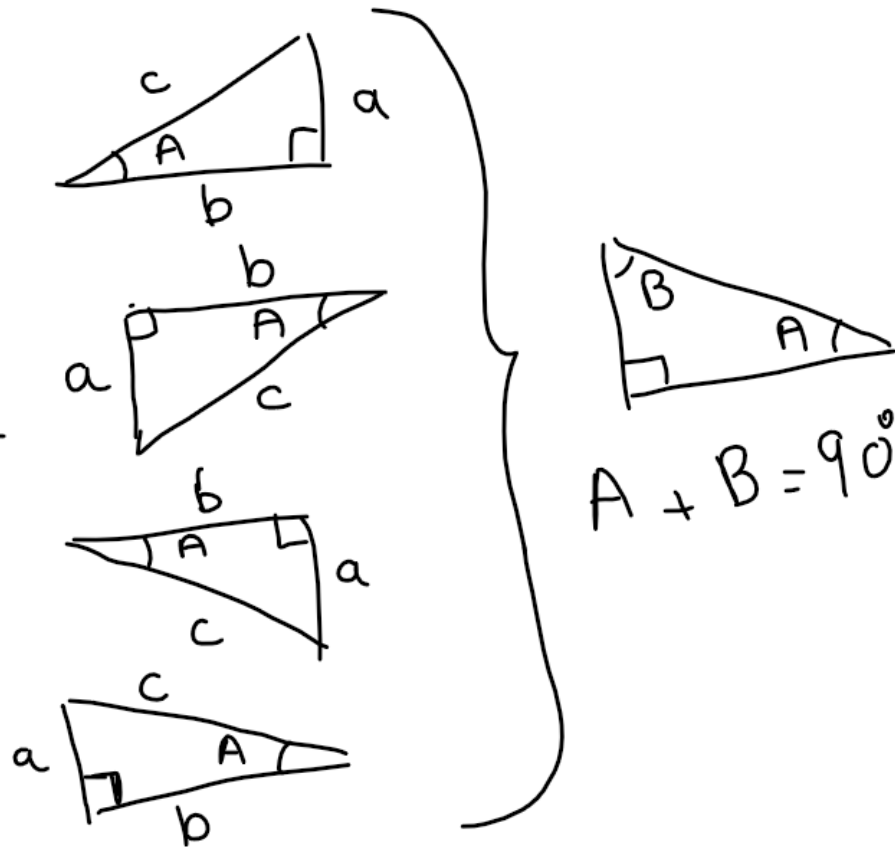
(1) $a^2 + b^2 = c^2$

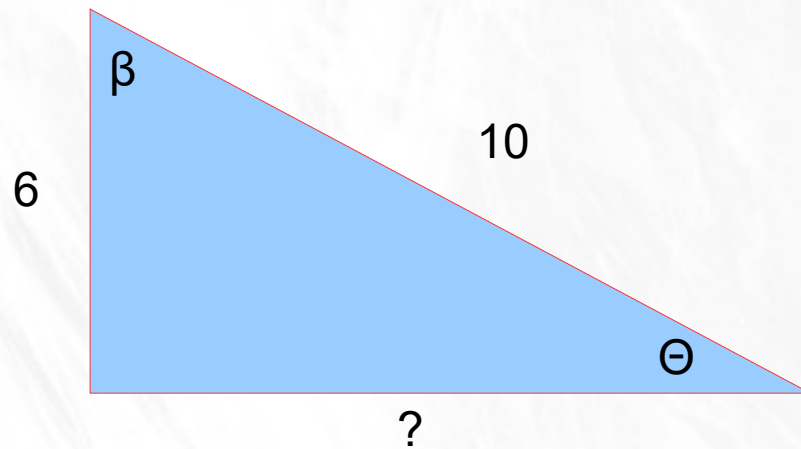
(2) $A = \tan^{-1}\left(\frac{a}{b}\right)$

(3) $\frac{a}{b} = \frac{\tan(A)}{1}$ } slope

(4) $\frac{b}{c} = \frac{\cos(A)}{1}$

(5) $\frac{a}{c} = \frac{\sin(A)}{1}$





1) Find the unknown side of this triangle
And the angles Θ and β

2) A vector AB has the components (100m, -50m) so its coordinates are $X=100$ $Y = -50$

Draw the vector in a X-Y coordinate system.

Use Pythagorean theorem to find the magnitude of the vector

Use \tan^{-1} to find one of the angle the vector makes with the horizontal

What is the polar notation ? $AB = \text{_____} @ \text{_____}$

3) what about a vector velocity $V_x=115\text{m/s}$ and $V_y=200\text{m/s}$

Same questions

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4) vector V (-100m/s, -100m/s) same questions